Remarks

Applicants offer no substantive amendment of currently pending claims 2 to 8 & 10 to 17 since in the applicant's view these claims define an invention which is both novel and non-obvious having regard to the disclosures of previously cited reference Saito (US5541926) and newly cited reference Peres (US5999533), whether taken singly or in combination. Claim 10 has, however, been amended to correct an inconsistency which is self-explanatory. Applicant apologizes for the oversight in not having noted the inconsistency on previous occasions.

The Examiner had previously indicated that of currently pending claims 2 to 8 & 10 to 17, claims 2 to 8 & 10 to 16 were allowable. Applicant then amended claim 17 to render it consistent with the "allowed" claims in expectation that this application would proceed to grant of a patent. However, the Examiner has now retreated from his previous position through his contention that claims 2, 3, 10 & 17 are rendered obvious having regard to a combination of Saito and Peres. The applicants respectfully disagree with the Examiner's newly formulated rejection under 35 U.S.C. 103(a) for the reasons provided in the following submission.

The present invention relates to a flexible and dynamic scheduler and shaping function for assembling asynchronous network packets from TDM frame based traffic that satisfies at least all the requirements of ATM adaptation layers 1, 2, and 5 running simultaneously. It is based around a credit based mechanism that accumulates against a threshold as a mechanism for dispatching packets into the asynchronous network from frame based TDM channels, where each TDM frame supports a plurality of data structures each comprising one or more channels. The credit based mechanism issues credits at a substantially constant rate, assigns the credits to each data structure according to the size of that data structure, determines for each data structure a

threshold number of assigned credits and, when said threshold value is reached, assembles that data structure into cells or packets for dispatch into the asynchronous network. In contrast to either Saito or Peres, the scheduler of the invention puts out a Channel (Byte) Transmission Event for each and every channel in a channel map which accumulates against its respective packet connection. The packet connection references store information regarding size, which may be state based according to the next packet and from this a threshold and Cell Transmission Event is derived. The cell transmission event is precise and perfectly shaped by this mechanism, such that a cell is put out exactly at the right point in time, with no bunching or jitter about the ideal.

In this manner each packet connection may have transmission rates that are independent of the STM rates because of packet overhead which varies. Also, each connection may be mutually independent, may be non-uniform, and there is no limitation on what packets and formats may be assembled from single or multiple TDM channels. The input channels may also be time slot switched to create arbitrary groups. No reliance is made on any other shaping indication.

In contrast with the present invention, Saito discloses a scheduler to allow cell traffic rates not necessarily tied to fixed STM rates by issuing asynchronous (to the input) cell transmission events running on its own clock. STM data is therefore buffered in a rate adaptive FIFO buffer, and the ATM side runs faster, decoupling the cell stream rate by insertion of idle cells. A cell is assembled according to the actual data fill in the FIFO buffer being sufficient, or otherwise an idle cell is inserted. Where that data is sufficient, a cell is assembled and dispatched. The sufficiency criteria can allow for non-uniform cell size such as AAL-1 pointer cells, and partially filled cells. In fact, this disclosure is limited to AAL-1 alone.

The scheduler cell clock disclosed in Saito can be varied in one embodiment to take into account the use of the network to apply some shaping to

the cell dispatch so that cells are not put out in a bunch, although the shaping is rather crude. There is no disclosure of how more than one packet connection is supported or how more than one connection is scheduled. It is presumed that this is achieved by duplicating the whole apparatus.

In the case of Peres, there is disclosed a means of single channel adaptation (SCA), i.e. one TDM channel to an AAL-1 ATM VCC. Peres does not disclose channel multiplexing.

The focus of the disclosure of Peres is the scheduling process based on a cyclical timing wheel. The wheel spins at an integer multiple of the STM frame rate of 125us and an even integer multiple of the number of bytes per cell (47 for unstructured AAL-1 SCA) where there is one byte per 125us. In the preferred embodiment, the wheel is divided into 47 sectors of 64 cell pointers. Therefore the scheduler puts out deterministic and exactly periodic synchronous cell transmission events.

The shortcoming of this scheduler is that all the cells must be uniform, i.e. have the same number of channel bytes, since the wheel size and speed is fundamentally linked to this. Consequently, it is impossible to support non-uniform cells such as multiple channel adaptation along with partially filled cells and other adaptation layers because of the complexity of finding a wheel size and speed that is a least common multiple of all the various sub-multiples that may be changed on a dynamic basis, especially when time slot switching.

In the present invention, one limitation in the independent claims is the feature of "assigning the credits to each said data structure according to the size of that data structure". There is no mention in Peres of the size of the cell being considered beyond an initial configuration. It is this feature of the present invention that provides its many capabilities that are absent in Peres.

Similarly, for Saito, there is a cell clock that runs irrespective of size. The size that is then checked is the buffer fill but not accumulated credits and, consequently, this does not provide automatic shaping of the cell stream as it may immediately dispatch more than one cell.

Both Peres and Saito use cell based scheduling running at a continuous rate. This is not a credit based but a demand based system. Saito immediately satisfies all demand; whereas Peres synchronizes the demand to the input in a restrictive manner. In contrast, the present invention generates actual credits according to input rate, but decouples the packet stream rate completely by allowing a separate process to generate the implicated cell stream. This works universally for synchronous and asynchronous inputs, and whatever the packet stream will be, however formatted or filled, with perfect shape at source. Consequently, the combination of the disclosures of Saito and Peres as contended by the Examiner cannot provide the credit based system proposed by the present invention. Nor would a skilled person contemplate such a combination given these disclosures mutually different scheduler clocks and strategies which satisfy demand in completely different ways.

In view of the foregoing, the Examiner's 35 U.S.C. 103(a) rejection of claims 2, 3, 10 & 17 cannot be sustained.

In view of the above, it is believed that this application is now in order for allowance.

Respectfully submitted,

Date: July 6, 2004

William M. Lee, Jr.
Registration No. 26,935

Barnes & Thornburg LLP
PO Box 2786
Chicago IL 60690-2786
(312) 357-1313 Telephone
(312) 759-5646 Facsimile
(312) 214-4811 Direct